Bio-Inspired Energy Efficiency: SBS West Ventilation

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Previous Project Description

- To design a ventilation system that increases the energy efficiency of SBS West while bringing the building up to standard code. The design will be added on to the current HVAC system and to be inspired by nature.
- **Importance:** SBS West is inefficient with its energy use and does not meet current standards for ventilation.
- **Project Sponsor:** Jon Heitzinger (Facility Maintenance)



Updated Project Description

• To design a ventilation system that increases the energy efficiency of SBS West while bringing the building up to standard code. Focusing on exhaust and relief air, rather the intake air and whole system. The design will be added on to the current HVAC system and to be inspired by nature.

Understanding the Current System (Blueprints)



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Understanding the Current System (Blueprints)



Figure 2: Blueprint of Intake/Exhaust Vents

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Understanding the Current System (Walkthrough)



Figure 3: SBS West Rooftop Vents



Figure 4: Portion of Ducting system

Understanding the Current System (Walkthrough)



Figure 5: Pneumatic HVAC System



Figure 6: Gauge Outputs of HVAC

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Hot Water Temp.

Converter

Gauges



Original Final Design

- Elevated Solar Panel
- Vents on casing
- Mechanical arm to actuate panel
- Fans and damper to economize/ filter air
- Inside air mixes with outside air
- Distributed throughout building



Figure 7: Original Final Design



Updated Final Design

- Replace existing ridge on roof of SBS West
- New ridge will consist of solar panels on South side of building (3' x 5')
- Steel casing that houses the intake and exhaust air
- Vents actuated by smart material on metal casing



Computer Aided Model of Design



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Figure 9: Engineering Drawing of Housing



Bill of Materials

Part	Part Name	Qty	Description	Functions	Material	Dimensions	Cost	Link to Cost estimate									
								https://www.metalsdepot.com/steel-products/steel-squar									
				Structural		1-1/2 X 1-1/2 X 1/4 wall		e-tube?gclid=Cj0KCQiArenfBRCoARIsAFc1FqdhaOSaj8nm									
1	Frame	4	Structure of design	Integratey	A500 Square Steel Tube	(in) Length: 20 ft	\$136.00	PqN66L11h9nli7oxGVXILfjY-YzKZQzetZdFmu3YRxMaAq0u									
				Protects Against													
2	Panelling	3	Side and top sheets	Weather	Galvanized Steel Sheet	5 x 10 ft	\$346.50	https://www.metalsdepot.com/steel-products/steel-sheet									
3	Solar Panel	2	Panel to collect solar	Collects Solar	Solar Panel	3 x 5 ft	\$310.00	https://www.altestore.com									
				Converts DC				https://www.wholesalesolar.com/2931725/sma/inverters									
4	Inverters	2	Power converter	power to AC	Inverter	28.5 X 21.1 X 7.8 in	\$1,325	/sma-sunny-boy-5.0-us-inverter									
				Filters incomina													
5	Filters	6	HVAC FIlter	air into building	Filter	20 X 20 X 2 in	\$50.70	https://filterbuy.com/air-filters/20x20x2/									
				Distributes air				https://www.alliedelec.com/ebm-papst-55416-27250/70									
6	Fan/Blower	2	Cross Flow Blower	into building	Blower	108 X 201 X 90 mm	\$76.60	105093/?mkwid=sNCm3u1fw&pcrid=30980760979&pkw									
	Smart		Shape memory			6000 X 2000 X 60		https://www.alibaba.com/product-detail/High-performan									
7	Material	5	material	Actuate vents	Nitinol	mm	\$190	<u>ce-Ti-Ni-nitinol-super_60773239543.html?spm=a2700.7</u>									
			Т	otal Cost Estimat	\$2,434.80												

Figure 10: Bill of Materials

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Design Requirements

Customer Requirements

- Must be bio-inspired
- Must increase energy efficiency of building
- Must have a short pay-off
- Must provide the same services as current system
- Must be easy to maintain
- Must be space efficient
- Must not generate excess noise pollution
- Must have adjustable times
- Must be safe
- Must bring building up to code

How Does the Design Meet the Customer Requirements?

- Vents and smart material are bio-inspired
- System will provide same services as current system since the system will be added to the current HVAC system
- Will increase energy efficient of building by exhausting the existing air in the building
- Easy to maintain since maintenance will mostly be clearing solar panels and changing filters
- System will not be larger than the current system since it will be added to the current system
- Will bring building up to proper ventilation codes

Current Semester Schedule



Figure 10: Current Semester Gantt Chart



Next Semester Schedule

	START DATE	END DATE	DURATION (WORK DAYS)	TEAM MEMBER	PERCENT COMPLETE	MONTH 1				MONTH 2				MONTH 3					MON	ITH 4	į.	MONTH 5			
IASK NAME						W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Second Semester With Budget																									
Finalize Bill of Materials with Client and Sponsors	1/15	1/25	10	All	0%	1																			
Order/ Buy Materials	1/25	1/31	6	All	0%																				
Fabriction of Prototype	2/1	2/26	25	All	0%																				
Finalize Website	2/26	3/30	34	All	0%																				
Test of Prototype	2/26	3/15	19	All	0%																				
Iterate Prototype (If Needed)	3/15	5/1	46	All	0%																				
Second Semester Without Budget																									
Review Current Design	1/15	1/25	10	All	0%																				
Walk Through SBS for Implementation	1/25	2/15	20	All	0%																				
Redesign with New Information and Criteria	2/15	2/20	5	All	0%																				
Iterate Process	2/20	5/15	85	All	0%																				

Figure 11: Semester Two Tentative Schedule



Proposed Budget

1) Beta Prototype (low budget): ~\$500 - \$1000

- a) Machined parts ~ \$150 \$200
- b) 3-D printing ~ \$100 \$150
- c) Fasteners ~ \$50 \$100
- d) Variable costs ~ \$100 \$200
- 2) Scaled Alpha Prototype (medium budget) :~\$1000 \$1500
 - a) Machined parts ~ \$250 \$500
 - b) 3-D printing ~ \$100 \$150
 - c) Fasteners ~ \$100 \$200
 - d) Variable costs ~ \$200 \$400
- 3) Actual Alpha Prototype (ideal budget) :~\$1500 or greater
 - a) Machined parts ~ \$500 \$1500
 - b) 3-D printing ~ \$100 \$150
 - c) Fasteners ~ \$100 \$200
 - d) Variable costs ~ \$500 or greater



Current Budget

Current Budget: \$0

Spent to Date: \$0

Balance: \$0



Potential Sponsorship

- Northern Arizona University Green Fund
 - \circ Refining and working with Dr. Wade on Green Fund proposal
 - Estimated funding: Unsure
- Arizona Power Supply
 - Team has a contact
 - Client has seperate contact
 - Estimated funding: Unsure
- Mechanical Engineering Department
 - If unable to obtain funding
 - Estimated funding: Unsure



Questions, Comments, Concerns, or Appraisal